ALIGNMENT/RETENTION DEVICE FOR CONNECTOR-LESS PROBE

BACKGROUND

In the development and manufacture of modern electronic circuits, testing of the circuits, whether it be for design debug, design confirmation, or the troubleshooting of defective circuits, is an indispensable activity. In order to evaluate or debug high-speed digital circuits, accurate measurement and display of signal waveforms and alternating current (AC) characteristics are often desired.

In many instances the measurements are performed by specifically designed probes, which have predefined physical and electrical qualities. The electrical qualities of a probe determine, in part, the response to the AC characteristics, the accuracy of the measurement, and the extent to which the probe detects the signal without detrimentally affecting the operation of the system or circuit being probed. One measure of a probe's intrusiveness is the loading presented by the probe on the circuit. High probe tip capacitance causes circuit loading problems for circuits with fast edge rates. Minimizing the capacitance associated with the probe has been one typical solution for reducing the loading and intrusiveness of the probe.

In this regard, a recent development is a probe system that comprises a semi-rigid support attached to a probing end of a probe. A spring pin and an isolation network are attached to the semi-rigid support. The semi-rigid support permits probing without the use of a mating connector. This so-called connector-less probe can be used to probe printed circuit boards and buses. Such a probe system is described in U.S. Patent Application Serial Number 10/373,820, entitled "Connector-Less Probe" filed 25 February 2003 by Brent A. Holcombe et al. which is incorporated herein by reference.

SUMMARY

In representative embodiments, an alignment/retention device is disclosed. The device includes a housing having a first side and an opposing second side. The housing includes an opening which extends from the first side to the second side. Multiple alignment pins are imbedded in the housing and extend external to both the first and second sides. On the first side the alignment pins are capable of insertion into matching holes on the electronic probe, and on the second side the alignment pins are capable of insertion into matching holes on an electronic circuit assembly.

Other aspects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings provide visual representations which will be used to more fully describe the invention and can be used by those skilled in the art to better understand it and its inherent advantages. In these drawings, like reference numerals identify corresponding elements.

Figure 1 is a drawing of an exploded, perspective view of a probe system with an alignment/retention device in a representative embodiment.

Figure 2 is a drawing of a side view of the probe system with the probe system of the representative embodiment of Figure 1.

Figure 3A is a drawing of a top view of the alignment/retention device of the representative embodiment of Figure 1.

Figure 3B is a drawing of a side view of the alignment/retention device of the representative embodiment of Figure 3A.

Figure 3C is a drawing of an end view of the alignment/retention device of the representative embodiment of Figure 3A.

Figure 3D is a drawing of a bottom view of the alignment/retention device of the representative embodiment of Figure 3A.

Figure 4A is a drawing of a dimensioned top view of the alignment/retention device in the representative embodiment of Figure 3A.

Figure 4B is a drawing of a dimensioned side view of the alignment/retention device in the representative embodiment of Figure 3A.

Figure 4C is a drawing of a dimensioned end view of the alignment/retention device in the representative embodiment of Figure 3A.

DETAILED DESCRIPTION

Various embodiments of an alignment/retention device for a connector-less probe are shown in the drawings for purposes of illustration. These embodiments can be used to obtain hands-free probing or testing of electronic devices and circuits. Such embodiments are especially useful in the electronic test of printed circuit boards, and can be used, for example, with the test probes of an oscilloscope, logic analyzer, or other electronic tester. They provide greater contact stability and alignment for the test points on the item under test. In particular, in conjunction with a connector-less probe they provide a low capacitance, non-destructive method for probing electronic signals on printed circuit boards having a connector-less probe and a related set of test points.

In the following detailed description and in the several figures of the drawings, like elements are identified with like reference numerals.

Figure 1 is a drawing of an exploded, perspective view of a probe system **100** with an alignment/retention device **110** in a representative embodiment. In figure 1, three major components of the probe system **100** are shown. These components are an electronic probe assembly **115**, the alignment/retention device **110**, and an electronic circuit assembly **120**. The alignment/retention device **110** is also referred to herein as the device **110**.

In a representative embodiment, the electronic probe assembly **115** comprises a flexible cable **125** which in turn comprises conductive wires that connect typically a test instrument (not shown in the figures) which could be, for example, an oscilloscope, logic analyzer, other electronic tester, other electronic system, or the like to an electronic probe test head **130** which is also referred to herein as electronic probe **130**. The electronic probe test head **130** can take various embodiments well known in the art but could involve an attachment mechanism **135** for mechanically attaching the electronic probe test head **130** to a device or circuit which is to be tested or probed. The attachment mechanism **135** could be, for example, one or more screws **135**, two of which are shown in Figure 1. The attachment mechanism **135** attaches to an appropriate mating device **196**, also referred to herein as a fastener part **196**, in order to securely affix the electronic

probe test head **130** to the device/circuit to be probed.

The electronic probe test head **130** further comprises a frame **140** within which at least one probe tip **145** (not shown in Figure 1) is housed. The probe tips **145** are placed in electrical contact with the device/circuit to be tested in order to electrically connect test points **150** on the device/circuit to be tested with the electronic tester.

The device/circuit to be tested is shown in Figure 1 as electronic circuit assembly **120** which could be, for example, printed circuit board **120** or the like. The printed circuit board **120** comprises various electronic components (not shown in the figures) at least one of which is attached to a test point **150**. Two parallel rows of test points **150** are shown in the embodiment of Figure 1. However, the number and layout of the test points **150** is implementation dependent.

In order to make a reliable measurement, the probe tips **145** of the electronic probe test head **130** must be accurately aligned to test points **150** on the electronic circuit assembly **120**. In addition, this alignment must be mechanically stable for the duration of the test. Embodiments of the alignment/retention device **110** enable accurate alignment of the probe tips **145** of the electronic probe test head **130** to the test points **150** on the electronic circuit assembly **120**.

More detailed descriptions of the alignment/retention device **110** will be provided below. As an overview, however, in a representative embodiment, the alignment/retention device **110** comprises a body **155**, also referred to herein as housing **155**, of material. The housing **155** has a first side **160** and an opposing second side **165**, wherein the housing comprises an opening **170** extending from the first side **160** to the second side **165.** In alternative, representative embodiments the alignment/retention device **110** further comprises a first key **175**, wherein when the first key **175** is aligned with a matching geometry **176** (not shown in the figures) on the electronic probe **130**, entry of the electronic probe **130** into the opening **170** is enabled. Otherwise, entry is prevented. In addition, the alignment/retention device **110** further comprises multiple alignment pins **180** which are imbedded in the housing **155** and which extend external to both first and second sides **160,165** of the housing **155**. On the first side **160** the alignment pins **180** are capable of insertion into matching holes (not shown in the figures)

on the electronic probe **130**, and on the second side the alignment pins **180** are capable of insertion into matching holes **185** on an electronic circuit assembly **120**. In Figure 1, the electronic circuit assembly **120** is shown with four alignment pins **180** placed in a rectangular pattern. However, the number and placement of the alignment pins **180** is implementation dependent. In other embodiments, the alignment/retention device **110** further comprises a second key **190** (see Figures 3A and 4A), wherein when the second key **190** is aligned with a matching geometry **195**, shown as hole **195** in Figure 1, on the electronic circuit assembly **120**, insertion of the alignment pins **180** into the matching holes **185** on the electronic circuit assembly **120** is enabled. Otherwise such entry is prevented. The second key **190** could be, for example, additional pin **190** imbedded in the housing **155** which extends external to the second side **165**. The matching geometry **195** on the electronic circuit assembly **120** is then the hole **195** of Figure 1 into which the additional pin **190** is capable of insertion.

In alternative embodiments, correct orientation of the alignment/retention device **110** to the pattern of test points **150** on the electronic circuit assembly **120** is obtained by the off-setting of one or more alignment pins **180** from the rectangular pattern shown in the figures. In which case, the additional pin **190** becomes unnecessary for preventing incorrect orientation of the alignment/retention device **110** to the pattern of test points **150**.

The alignment/retention device **110** further comprises the optional fastener part **196** which is capable of attaching the electronic probe **130** to the housing **155** of the alignment/retention device **110**. In the embodiment of Figure 1, the fastener part **196** comprises two threaded screw holes **196** into which a screw **135** attached to the electronic probe **130** can be inserted. While two fastener parts **196** (screw holes) are shown in Figure 1, only one fastener part **196** or more than two are also possible.

Note that in the embodiment of Figure 1, the axis of the alignment pins **180** is parallel to the axis of the opening **170**.

On the second side **165** of the alignment/retention device **110**, the alignment pins **180** can be attached to the electronic circuit assembly **120** following their insertion into the electronic circuit assembly **120** matching holes **185**. Such attachment can be effected,

for example, by soldering the alignment pins **180** into the electronic circuit assembly **120** matching holes **185**.

Figure 2 is a drawing of a side view of the probe system with the probe system **100** of the representative embodiment of Figure 1. In figure 2, the flexible cable **125** connected to the electronic test system (not shown in the figures) is attached to the electronic probe test head **130** which has frame **140**. The electronic probe test head **130** is held fast to the alignment/retention device **110** by means of the two screws **135** which are screwed into the two threaded screw holes **196** (see Figure 1) in the housing **155** of the alignment/retention device **110**. The housing **155** of the alignment/retention device **110** is attached to the electronic circuit assembly **120** (printed circuit board **120**) by insertion of the alignment pins **180** into matching holes **185** (see Figure 1) on the electronic circuit assembly **120**. For a permanent, mechanically stable attachment, the alignment pins **180** are solder to metalization surrounding the matching holes **185** on the electronic circuit assembly **120** after they are inserted into the electronic circuit assembly **120**.

Figure 3A is a drawing of a top view of the alignment/retention device **110** of the representative embodiment of Figure 1. In the representative embodiment of Figure 3A, the alignment/retention device **110** is shown with four alignment pins **180** molded into the housing **155** of the alignment/retention device **110** in the general vicinity of the four corners of the alignment/retention device **110** and surrounding the opening **170**. Also shown are two threaded screw holes **196** (fastener parts **196**) and the first key **175**. In the representative embodiment of Figure 3A, the first key **175** is shown as a protuberance extending into the opening **170**. Other geometries for the first key **175** including, but not limited to, pins embedded into the housing **155**.

Figure 3B is a drawing of a side view of the alignment/retention device **110** of the representative embodiment of Figure 3A. In the representative embodiment of Figure 3B, the alignment/retention device **110** is shown with alignment pins **180** molded into the housing **155** of the alignment/retention device **110** in the general vicinity of the corners of the alignment/retention device **110**.

Figure 3C is a drawing of an end view of the alignment/retention device **110** of

the representative embodiment of Figure 3A. In the representative embodiment of Figure 3C, the alignment/retention device **110** is shown with alignment pins **180** molded into the housing **155** of the alignment/retention device **110** in the general vicinity of the corners of the alignment/retention device **110**.

Figure 3D is a drawing of a bottom view of the alignment/retention device **110** of the representative embodiment of Figure 3A. In the representative embodiment of Figure 3D, the alignment/retention device **110** is shown with four alignment pins **180** molded into the housing **155** of the alignment/retention device **110** in the general vicinity of the four corners of the alignment/retention device **110** and surrounding the opening **170**. Also shown is the first key **175**. In the representative embodiment of Figure 3D, the first key **175** is again shown as the protuberance extending into the opening **170**. As stated above, other geometries for the first key **175** including, but not limited to, pins embedded into the housing **155**.

Figure 4A is a drawing of a dimensioned top view of the alignment/retention device **110** in the representative embodiment of Figure 3A. Figure 4B is a drawing of a dimensioned side view of the alignment/retention device **110** in the representative embodiment of Figure 3A. And, Figure 4C is a drawing of a dimensioned end view of the alignment/retention device **110** in the representative embodiment of Figure 3A.

In representative embodiments, dimensions of housing **155** are as follows: (1) length **A** = 1.340", (2) width **B** = 0.275", and height **C** = 0.196". The opening **170** has representative dimensions of (1) length **D** = 1.11" and (2) width **E** = 0.219". The first key **175** has dimensions of (1) protrusion extent **F** = 0.020" and (2) protrusion width **G** = 0.076". The alignment pins **180** have representative dimensions of (1) length **H** = 0.444" and diameter **M** = 0.040". The alignment pins **180** extend a length **I** = 0.141" above the first side **160** and a length **J** = 0.107" below the second side **165**.

In a representative embodiment, the fastener parts **196** are two threaded screw holes **196** that are drilled and tapped to accept number 1-64 screws. The screw holes **196** are typically centered laterally on the housing **155** a distance **K** = 0.058" from each end of the housing **155**. In representative embodiments, the housing **155** is a molded plastic with the alignment pins **180** being embedded into the housing **155** during the molding

process.

The alignment pins are typically beryllium copper plated first with a thickness of 0.000050" nickel and then 0.000010" of gold and are heat treated. A chamfer of 0.070" x 0.020" is typically added to the alignment pins **180** as an aid in the alignment and insertion of the alignment pins **180** into the matching holes **185** on the electronic circuit assembly **120**.

In a representative example, the second key **190** is an additional pin **190** having a diameter **L** = 0.030" and extending a distance **N** = 0.031" below the second side **165**.

A recent development with which the alignment/retention device **110** can be uses is a probe system that comprises a semi-rigid support attached to a probing end of a probe. A spring pin and an isolation network are attached to the semi-rigid support. The semi-rigid support permits probing without the use of a mating connector. This so-called connector-less probe can be used to probe printed circuit boards and buses. Again, such a probe system is described in U.S. Patent Application Serial Number 10/373,820, entitled "Connector-Less Probe" filed 25 February 2003 by Brent A. Holcombe et al.

In representative embodiments, the alignment/retention device **110** provides the advantage of being able to accurately align the probe tips **145** of electronic probes **130** to matching test points **150** on electronic circuit assemblies **120** as, for example, printed circuit boards **120**. Once aligned, alignment pins **180** on the alignment/retention device **110** can be soldered to the metalized test points **150** on the printed circuit board **120** which provides a mechanically stable environment for test. Once the test is completed, for ease of use and to minimize damage to the electronic circuit assembly **120** (the printed circuit board **120**), the electronic probe **130** can be removed from the alignment/retention device **110** leaving the alignment/retention device **110** attached to the electronic circuit assembly **120** (the printed circuit board **120**). Electronic disturbance of the electronic circuit assembly **120** following the test is thereby limited to only that caused by the test points **150**.

While the present invention has been described in detail in relation to preferred embodiments thereof, the described embodiments have been presented by way of example and not by way of limitation. It will be understood by those skilled in the art

that various changes may be made in the form and details of the described embodiments resulting in equivalent embodiments that remain within the scope of the appended claims.